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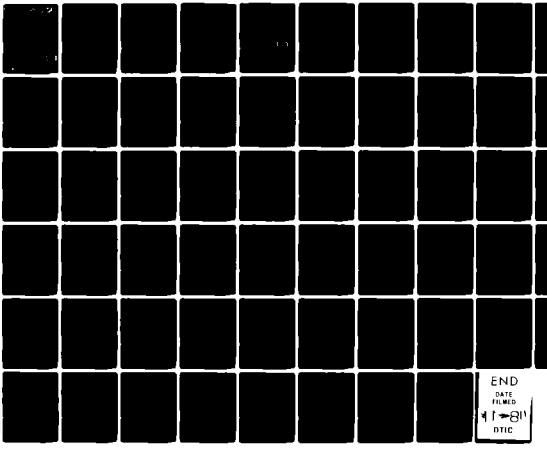

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A SIMULATION STUDY OF THE USE OF JTIDS IN TACTICAL MISSIONS

Mr. Richard Geiselhart
Mr. Larry J. Ivey
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DIRECTORATE OF EQUIPMENT ENGINEERING
DEPUTY FOR ENGINEERING
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WRIGHT-PATTERSON AFB, OHIO 45433

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A simulation study of the usefullness of the Joint Tactical Information Distribution System in a tactical situation was conducted using the A-10 flight simulator operated by the Crew Station Design Facility of the Human Factors Engineering Branch, Directorate of Equipment Engineering, Aeronautical Systems Division. This specific effort was funded by the Command, Control, Communication and Information Division of the Test and Evaluation Center, Kirtland AFB, N.M. Thirteen currently operational pilots from TAC and USMC units each flew →

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eight missions. The missions included both close air support and interdiction scenarios in a tactical environment, and the pilots were assigned to those conditions using an ABBA experimental design. Subjective data provided by the pilots showed a definite preference for the JTIDS system. Experimental results indicated that JTIDS offers the capability for low task lead navigation, better communications, and improved situation awareness. The potential benefits of the system include an increased probability of mission success and improved survivability.

FOREWORD

The simulation of JTIDS employed in this study was funded by the JTIDS Joint Program Office, Electronic Systems Division (ESD/DCB), L.G. Hanscom AFB, Massachusetts, and was managed by the Aeronautical System Division, Directorate of Avionics Planning (ASD/XRE).

The specific effort covered by this report was funded by the Command, Control, Communication and Information Division of the Test and Evaluation Directorate, Air Force Test and Evaluation Center, Kirtland AFB, N.M.

The work reported was performed at the Crew Station Design Facility, Human Factors Branch of the Deputy for Engineering, Aeronautical Systems Division, Wright-Patterson AFB, Ohio.

Acknowledgement is given to the Tactical Air Command pilots who flew the simulation missions during data collection.

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SECTION I

INTRODUCTION

Operational experience in Southeast Asia pointed up the importance of a real-time command and control net to air operations. In response to this need the Joint Tactical Information Distribution System (JTIDS) was developed. JTIDS is a secure, jam resistant, near real-time information net which contains integrated tactical, communication, identification and navigation data. Although JTIDS is essentially a communications system, it is somewhat of a departure from the conventional aircraft communications system, where the information comes to the pilot through the headset. In JTIDS the information is primarily presented to the pilot by means of visual display on the instrument panel; however, JTIDS still uses the audio channel in specific instances, i.e. warnings and some information reporting.

Because the information in JTIDS is presented visually, more than one piece of data can be displayed simultaneously, providing a wide variety of data to the operator at any given moment. (Audio information on the other hand is sequential and must be stored in short and long term memory.) This ability to provide large quantities of data enables JTIDS to provide a complete picture of the tactical situation on a moment-to-moment basis for the tactical pilot. There are many potential advantages of such a system. The increased situation awareness afforded the pilot through JTIDS could enable him to accomplish pre-planned and modified missions with increased effectiveness and enhanced survivability. In a close air support or air diverted mission, turn points, target identification and location, and IP to the target can be presented. At the same time the pilot can be made aware of threats, other aircraft, poor weather conditions, and location of air traffic to avoid.

Previous studies on JTIDS conducted in the Crew Station Design Facility (CSDF) were directed towards evaluating information requirements, symbology, time sharing, color versus monochromatic displays, and crew size considerations. Once the design of the system was accomplished, there still remained the question of the usefulness of the system in the tactical environment. This study was undertaken to provide data for evaluating some of the tactical advantages described earlier. It specifically compared simulated tactical missions with a JTIDS capability and without a JTIDS capability in the cockpit. Both close air support (CAS) missions and interdiction missions were simulated.

SECTION II

STUDY PROCEDURE

1. APPARATUS

The CSDF A-10 Flight Simulator was used as the test vehicle for this study (Figure 1). An out-the-cockpit visual scene was provided using a closed circuit TV system from a modified Link SMK-23 moving terrain model. The visual apparatus consisted of a Cohu high resolution, low light level TV camera and a Farrand optical probe, which transferred the mountainous terrain images to a Conrac 1000 line, black and white TV monitor. The scene was transmitted through a beam splitter to a parabolic mirror with a focal length of 54 inches. This provided approximately a 48 degree forward field-of-view (FOV) to the pilot with the image collimated to appear at infinity. The system provided simulated aircraft visual parameters of 360 degree continuous heading, 360 degree continuous roll, plus or minus 120 degree pitch, and 50 to 4000 feet altitude. A second SMK-23 provided a simulation of the A-10 Maverick cockpit display. A reduced FOV probe was used to simulate the Maverick TV picture transmitted to the A-10 cockpit. All Maverick controls were also simulated in the cockpit for weapons delivery. Both visual systems were synchronized through the Mark I computer so that the Maverick and out the window scenes were correlated as they would be in the real world.

The JTIDS display and symbology was generated on a Vector General, model 3404, symbol generator with a PDP-11/34A interface. The information was presented in the cockpit on a Kratos, three color, 5 x 7 inch, beam penetration tube using P-50 red and green phosphor. The threat information from the JTIDS data base was computed on the PDP-11 and transferred to the Mark I computer for RHAW voice warning generation through an MDEC Voice Warning System.

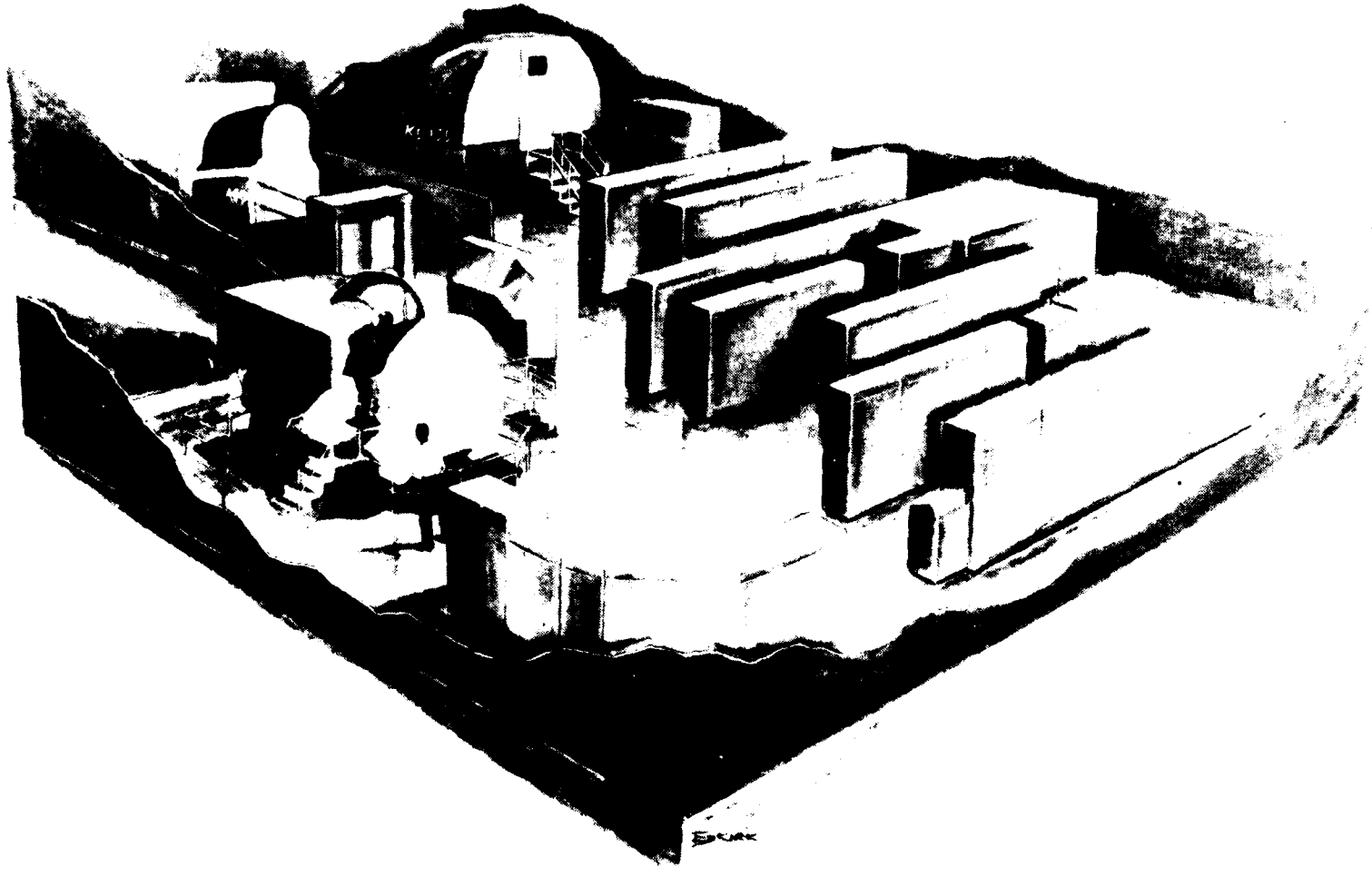


Figure 1 Crew Station Design Facility

All aircraft aerodynamics and aircraft systems were computed on the Link Mark I computer. In addition, data collection was recorded on magnetic tape. Figure 2 provides a block diagram of the apparatus.

2. JTIDS DISPLAYS AND CONTROLS

Symbology

A modified version of the basic Wright-Patterson Symbology Standardization Committee (SSC) symbols were used in Phase V. These minor changes were a result of pilot comment and request through the previous four phases of studies at the CSDF. The symbols shown below were color coded green for friendly, red for hostile, and yellow for unknown.


Tanks


Ships


Ground Troops


Submarines


Vehicles

A dashed line (- - - -) was used to indicate the forward edge of the battle area, (FEBA) and a combination dash dot line (- . - .) was used to identify political boundries.

Additional ground symbols were:


Airfield


Radar

Primary Target

Alternate Target

Primary Recovery Base

Alternate Recovery Base


Ground Targets on 40 mile or greater range

Aircraft were designated by one of three symbols. A hostile direct threat, i.e., a fighter equipped with all aspect radar, was represented by a "Double Delta" symbol color coded red  . Other types of aircraft used a standard aircraft symbol appropriately color coded. One's own aircraft was represented by  . All aircraft symbols were rotated to indicate aircraft heading. Number and type of air vehicles were further designated by an alpha numeric code. The alpha codes included "C" for cargo, "K" for tanker, "B" for bomber, "F" for fighter, and "H" for helicopter. For example, 3F (color coded red) represents three hostile, direct threat aircraft on a 270° heading.  2K (color coded yellow) represents two unknown tankers on a 90° heading.

Surface-to-air missiles (SAMS) were identified by the appropriate numerics for hostiles (6, 4), an H or C for friendly (Hawk or Chapperal), and an S for unknown. Anti-aircraft artillery (AAA) were indicated by the letter A. All air-to-ground symbols were appropriately color coded.

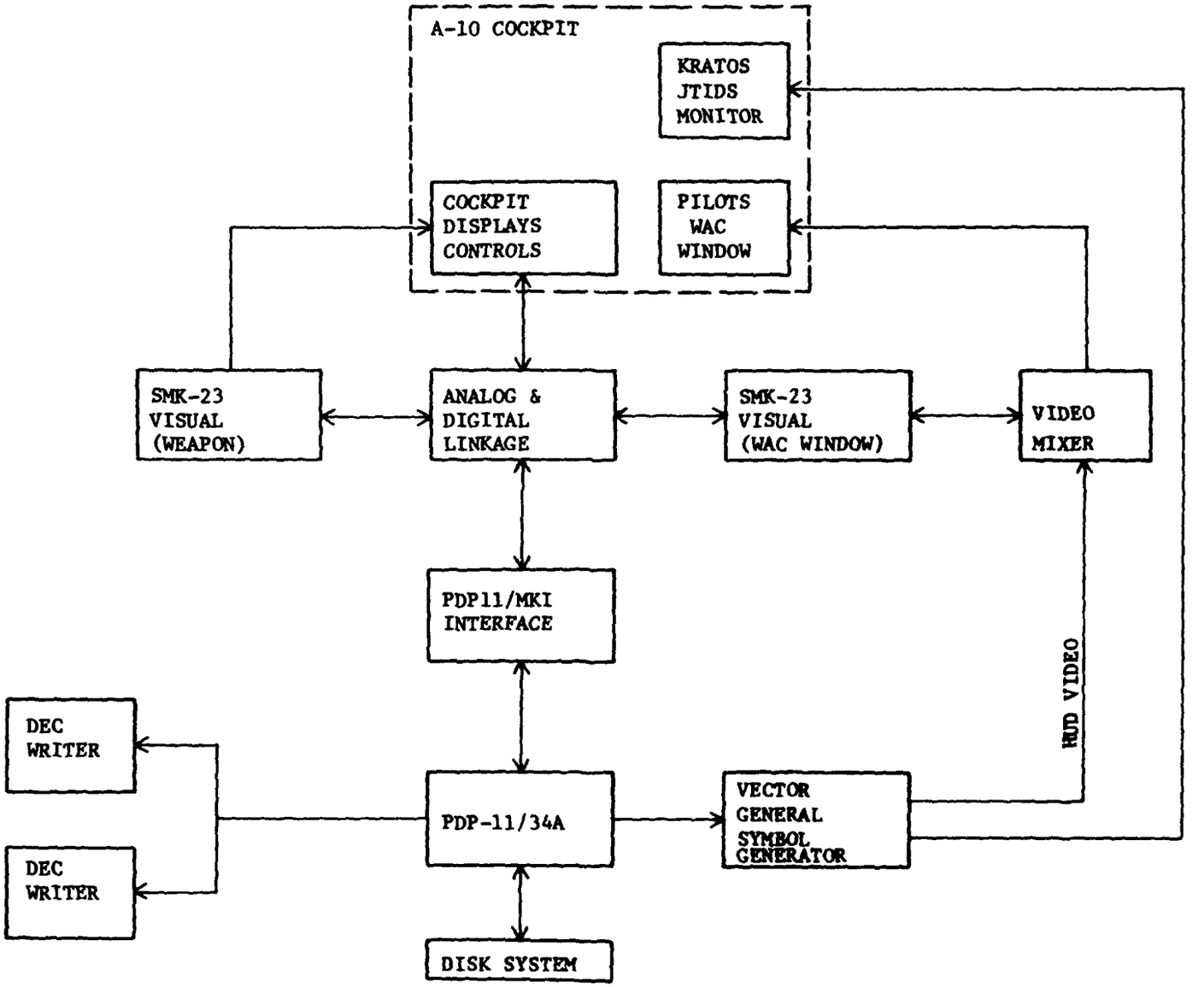
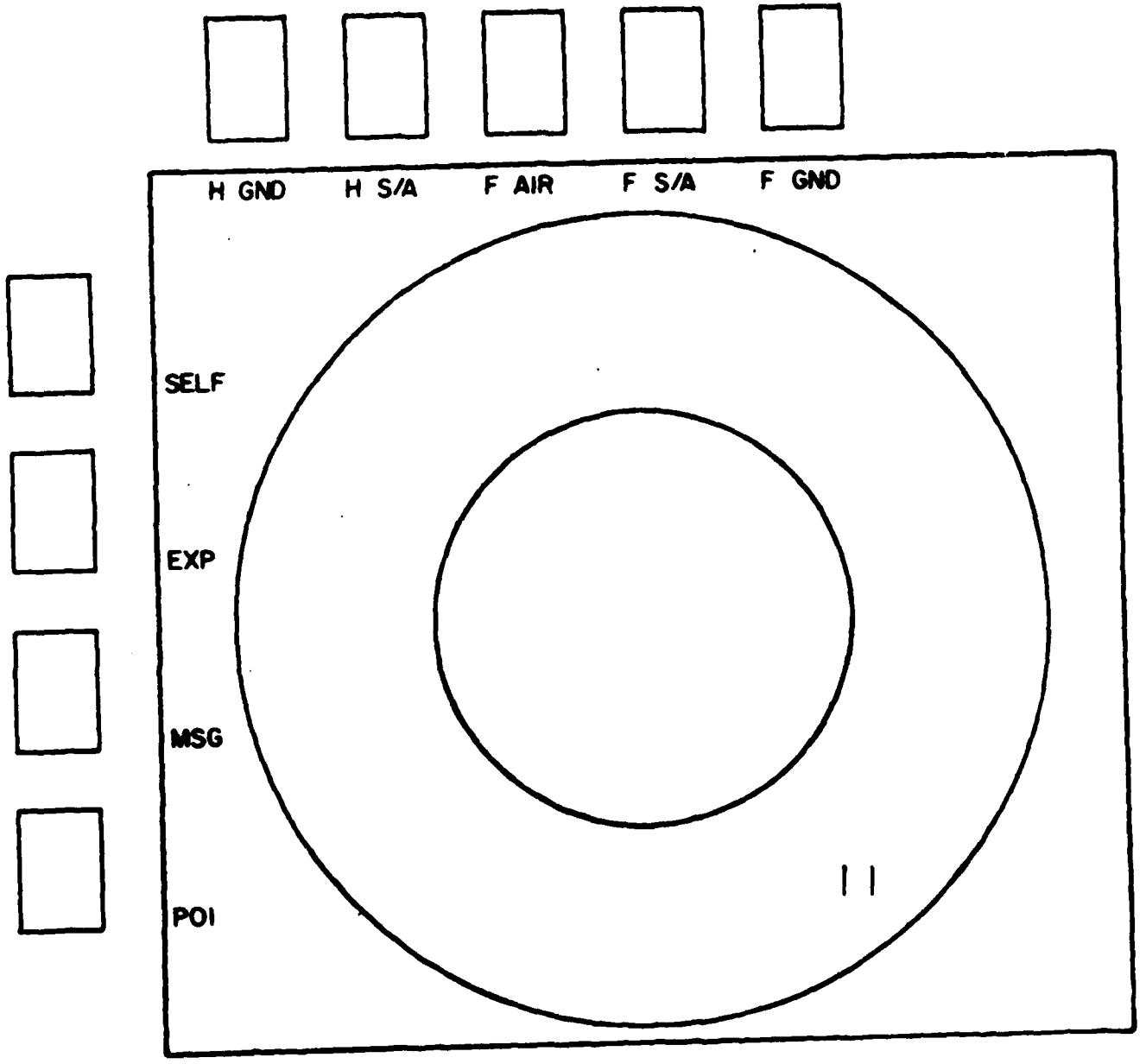


Figure 2 Block Diagram of A-10 JTIDS Simulation


H GND
H S/A
F AIR
F S/A
F GND
SELF
EXP
MSG
POI

Way points or turn points were indicated by a circle with a sequence number inside the circle (6) . Also, an occasional lower case "w" would appear on the display as a weather identifier at that specific geographical position represented on the display.

The number of symbols presented on the display at any one time was limited to a maximum of 40. Which symbols were presented was based on a priority logic (TAC Requirements Document) with the highest bumping the lowest. Therefore, if the maximum of 40 symbols was displayed and a hostile threat came into range, it would be shown and a friendly ground or some other lower priority symbol would be eliminated. An automatic declutter feature was also employed for this study. At a range of 40 miles and beyond, only hostile air and hostile surface-to-air threats were displayed.

3. JTIDS DISPLAY MODES AND SUBMODES

The general configuration of the JTIDS scope is shown in Figure 3. There were four alternate action, integrally illuminated legend switches on the left side of the scope for selecting various modes of operation, which are described below. Across the top of the display were five similar legend switches for selecting information options - also described below.

The JTIDS display used half and full range circles, with the aircraft heading and range in the upper right hand corner. Range was selected by moving a rocker switch located on the right side of the throttles. Each forward click increased the range by a factor of two, from 10 to 160 miles. Moving the thumbswitch back decreased the range in the same way. The ranges available to the pilot were 10, 20, 40, 80, and 160 miles respectively.

The JTIDS display itself was selected by advancing the toggle switch on the left (outboard) side of the A-10 throttles with the little finger on the pilot's left hand. Retarding the switch displayed weapons information, (Figure 3a) including number of missiles and rounds of ammunition remaining. The Maverick slew control was used to manipulate the position of a cursor symbol on the JTIDS display. Placing the hashmark over an aircraft symbol caused an alphanumeric readout to be displayed which showed heading, altitude, and closure rate. By slewing to the target the pilot was able to display information regarding the primary or secondary target. Weather and bearing to turn points could also be displayed by appropriately placing the hashmarks.

SELF MODE

When the pilot selected the self mode the switch above the self legend on the JTIDS scope would illuminate. The self mode was a "Heading Up" type display with the pilot's own aircraft in the center of the scope. Route and waypoint information to the target were displayed and moved along under the aircraft symbol as the aircraft changed position.

The five selectable information options described earlier were displayed in the self mode. Figure 4 depicts the JTIDS scope in the self mode with two information options selected (hostile ground and hostile surface to air). The caret mark on the scope denotes north heading. The other symbols are as described in the previous section of this report.

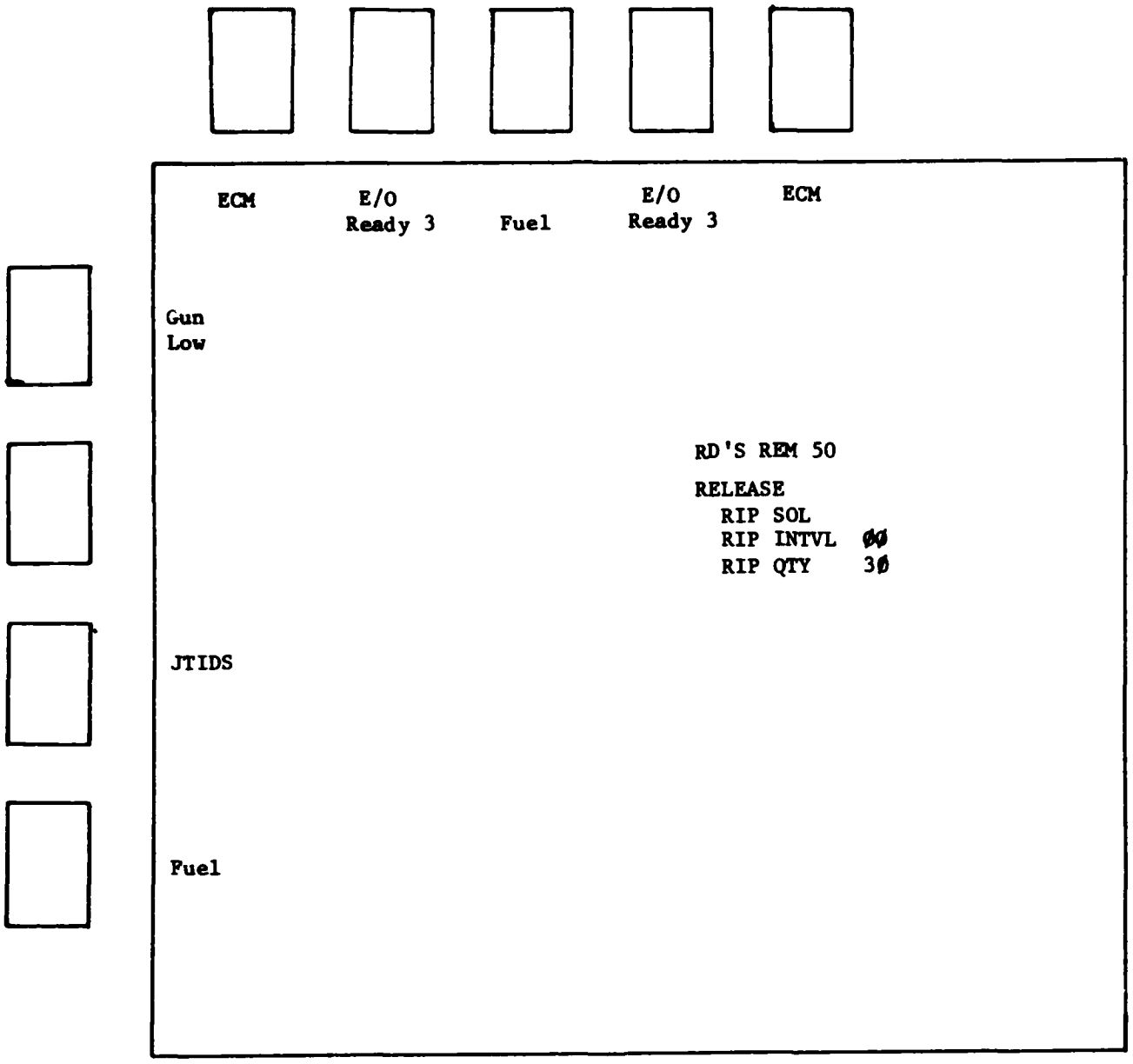


Figure 3a JTIDS Scope in Weapons Mode

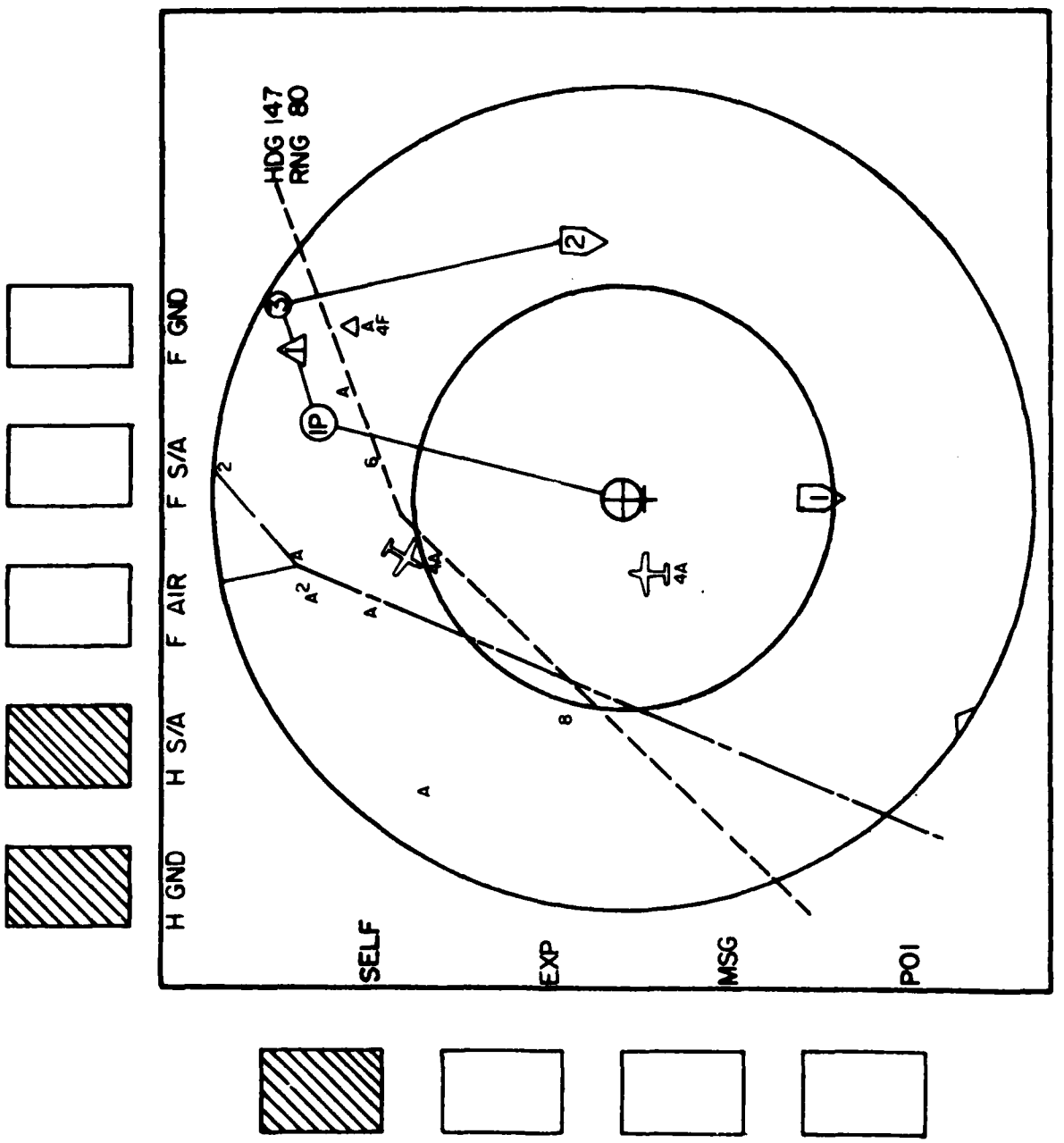


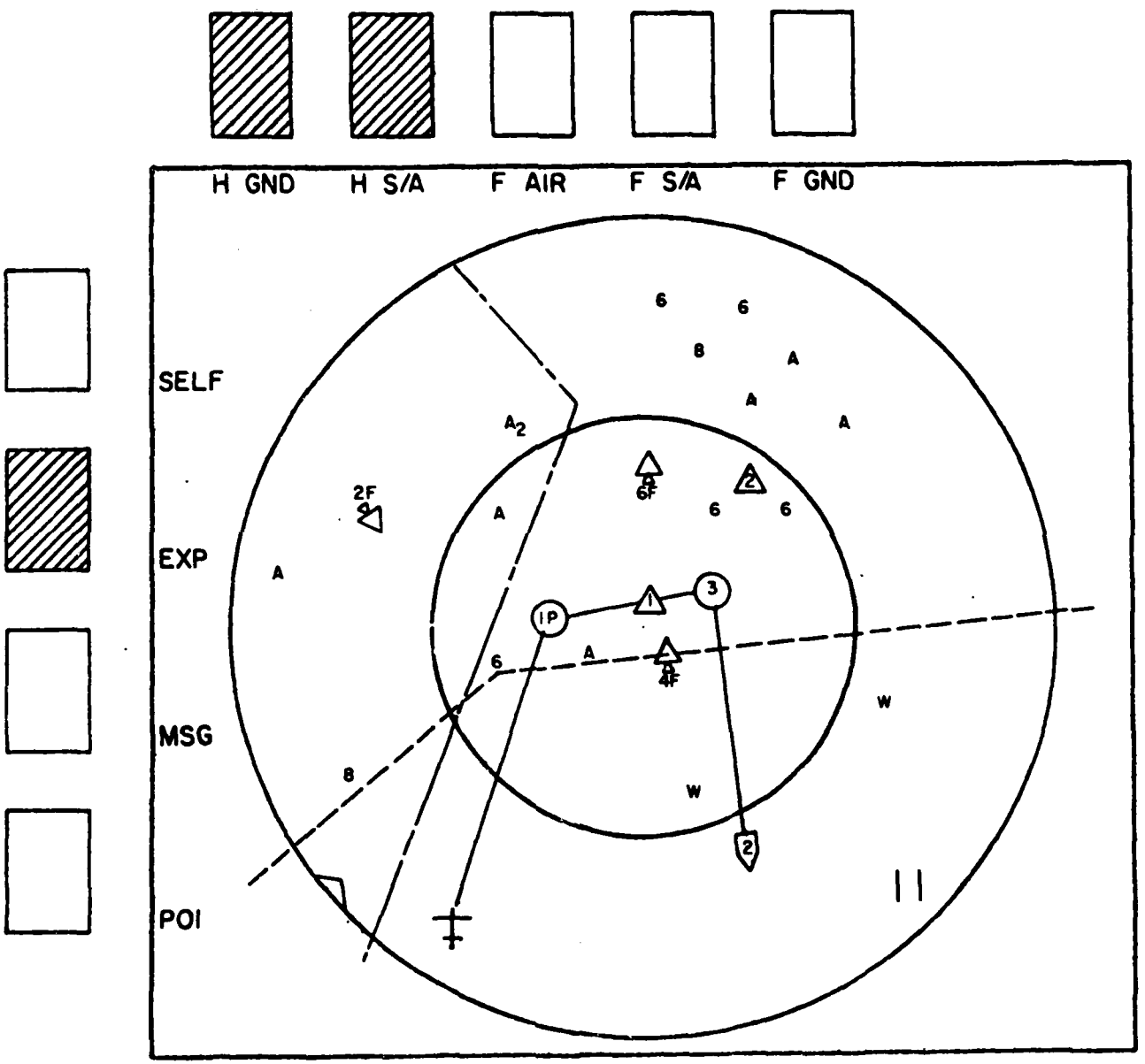
Figure Self Mode with Two Information Options Selected

EXPAND MODE

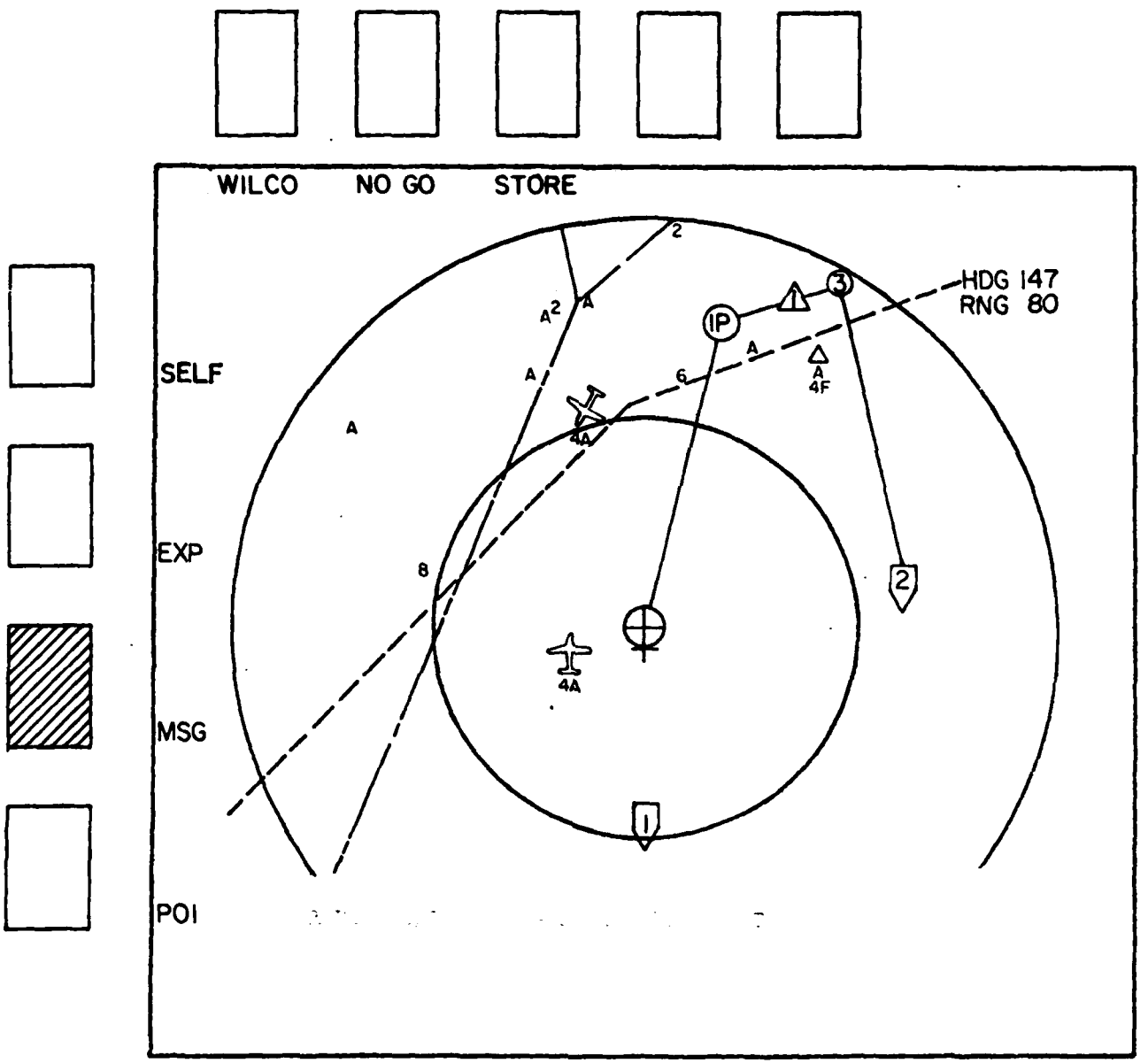
By engaging the expand mode the pilot could remove his own aircraft symbol from the center of the JTIDS display and position some other ground point in the center of the scope. This was done by slewing the hash marks the selected point and pushing in on the pressure sensitive cursor slewing button. By moving the cursor to the uppermost edge of the screen and expanding around that point, the pilot was able to effectively extend the viewing range past the 160 miles to which he was initially limited. The mode was called expand because by designating an object at long range, (e.g., the target), then reducing the range while that point is in the center of the display, the pilot could expand the area for a closer examination of the target area. The most frequent use of the expand mode was to assess the defenses in the target area. In a typical mission the pilot would expand the target area as he approached the IP. Figure 5 shows the expand mode. The same five information options were displayed that were available in the self mode.

MESSAGE MODE

Whenever a command message was received the Message Mode light would illuminate and the word "Command" was heard over the headset. The message text appeared at the bottom of the screen, and the options WILCO, for will comply; NOGO, for cannot comply; and STORE, for storing in computer memory would appear at the top of the scope (see Figure 6). All other information on the scope at the time of the command remained. If the pilot selected "WILCO" or "NOGO" the message disappeared from the scope and the display option previously selected was automatically reinitiated. If for some reason the pilot was unable to act on the command message, then he could select "STORE" and store the message in one of three memory locations available for later recall. Once the "STORE" option was selected, the system would again be returned to the previously selected option; however, the MSG switch remained illuminated until the MSG option was later reselected and appropriate disposition made.


H GND
H S/A
F AIR
F S/A
F GND
SELF
EXP
MSG
POI
6
6
B
A
A
A
A2
2F
6F
2
A
6
6
A
1P
1
3
6
A
4F
W
B
W
2
11

Expand Mode


WILCO
NO GO
STORE
SELF
EXP
MSG
POI
HDG 147
RNG 80
IP
1
2
3
4A
4F
A
6
8

When the MSG mode was selected by the pilot, five options would appear across the top of the display; ABWX (Abort Because of Weather); ABMX (Abort for Mechanical Reasons); RCL1, RCL2, and RCL3 (the three message store locations) (see Figure 7). Once an option was selected or a message recalled and acted upon, the display returned to its previous condition.

POINT OF INTEREST (POI) MODE

The POI mode was used to designate a target of opportunity, or some threat not on the JTIDS net (see Figure 8). In order to initiate this mode, the pilot depressed the switch adjacent to the POI legend and an "X" would appear in place of the hashmarks. The pilot could then slew the X to any location on the scope, and have the range and bearing to that point displayed and transmitted along with voice traffic describing the "Point of Interest." The POI mode was not employed in this study.

4. PROCEDURE

Each pilot flew eight missions for data in the A-10 simulator, four missions with the JTIDS display available, and four without the JTIDS display available. The pilot also flew two types of missions - close air support (CAS) and interdiction. A detailed description of the experimental design is presented in Subsection 5. Prior to the simulator test runs, each pilot was given an "in-briefing" on the purpose of the study, followed by a two to three hour familiarization and training session in the simulator.

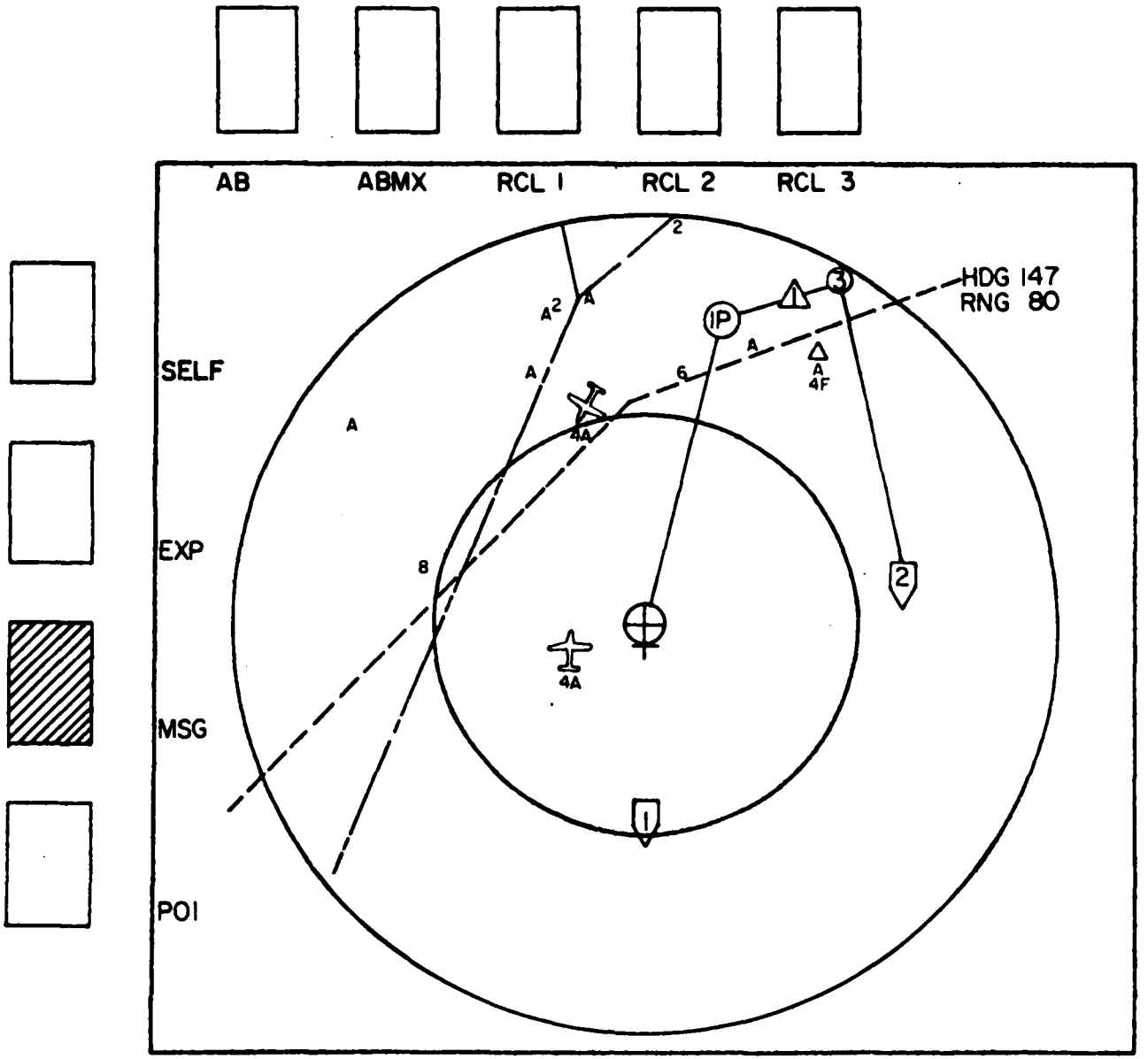
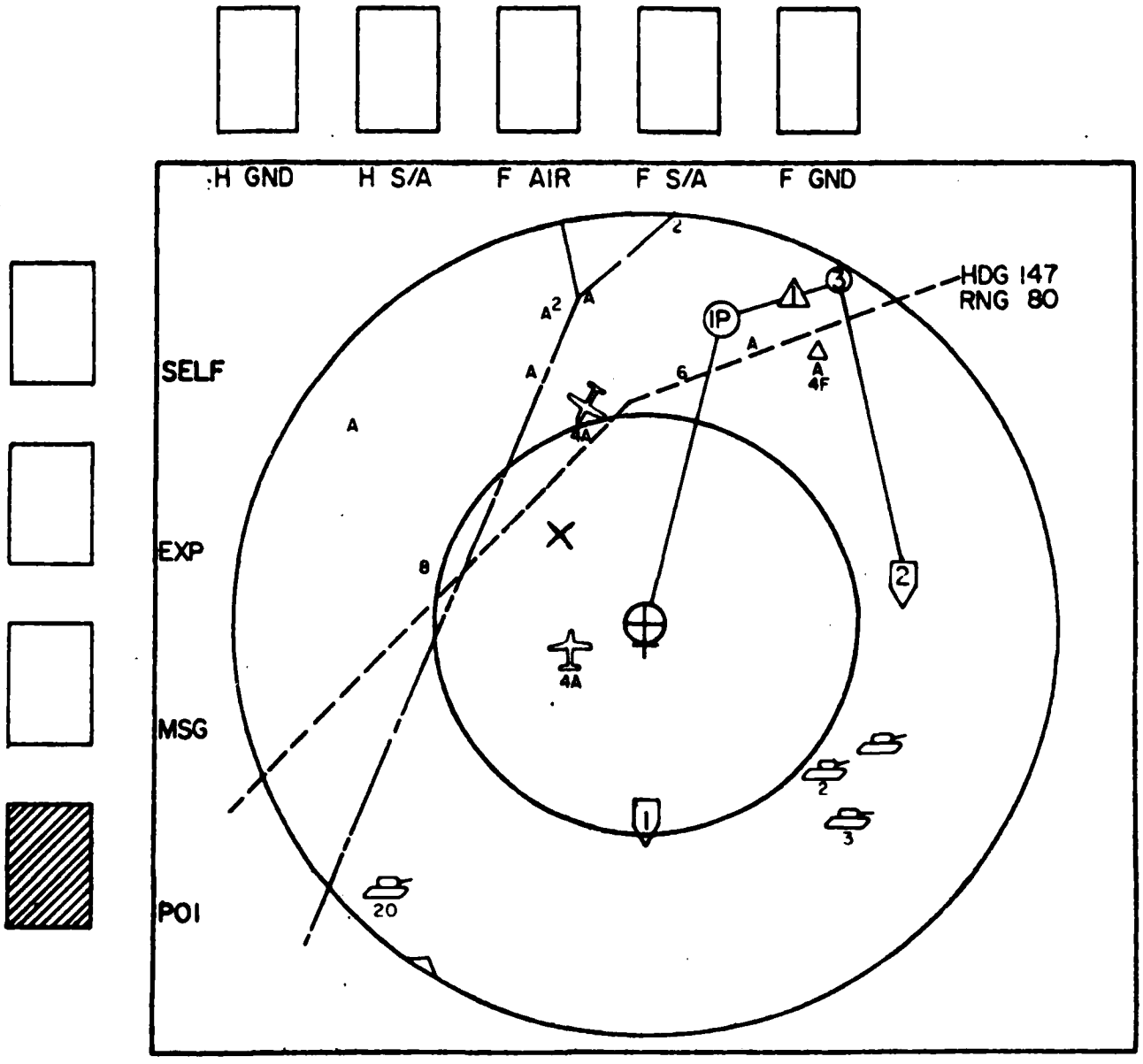


Figure 7 Message Mode (Operator Initiated)



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ure POI Mode

When the CAS without JTIDS missions were flown, the experimenter at the simulator control console acted as the forward air controller (FAC) and communicated with the "STRIKE" aircraft. The pilot was set up in an orbit pattern within 20 miles of the frontal edge of the battle area (FEBA) and the CAS mission would be radioed to the "STRIKE" aircraft by the simulated FAC. Communication jamming during the mission was simulated according to current TAC doctrine. The experimenter acted as FAC throughout mission until the target pass was completed. Those CAS missions flown in the JTIDS mode were conducted in the same manner, except that the information provided by the FAC on the audio channel was also displayed on the JTIDS scope, and depicted the IP and heading to target. (see Figure 8a). The jamming scenario for the CAS/JTIDS experimental condition included both audio jamming and jamming of the JTIDS net. JTIDS navigation information, which would be internal to the aircraft, was not affected by the jamming.

Interdiction missions flown without JTIDS were preceded by a mission briefing in which the pilot was provided with a map with the INS turnpoints and the route shown. The pilot was also briefed on the details of the target area. The Horizontal Situation Indicator (HSI) was set up so that the CDI would indicate the turn point as it came up. Following the briefing the pilot flew the mission. On those interdiction missions with the JTIDS capability available, the pilots were also briefed, but only in a very general way. The primary mission information was displayed on the JTIDS scope. The jamming scenario on the interdiction was similar to that set up for the CAS missions.

The threat warnings for the CAS with JTIDS, and the interdiction missions with JTIDS came over the audio channel as well as the cockpit display. In the "No JTIDS" condition, threats were on the audio channel only.

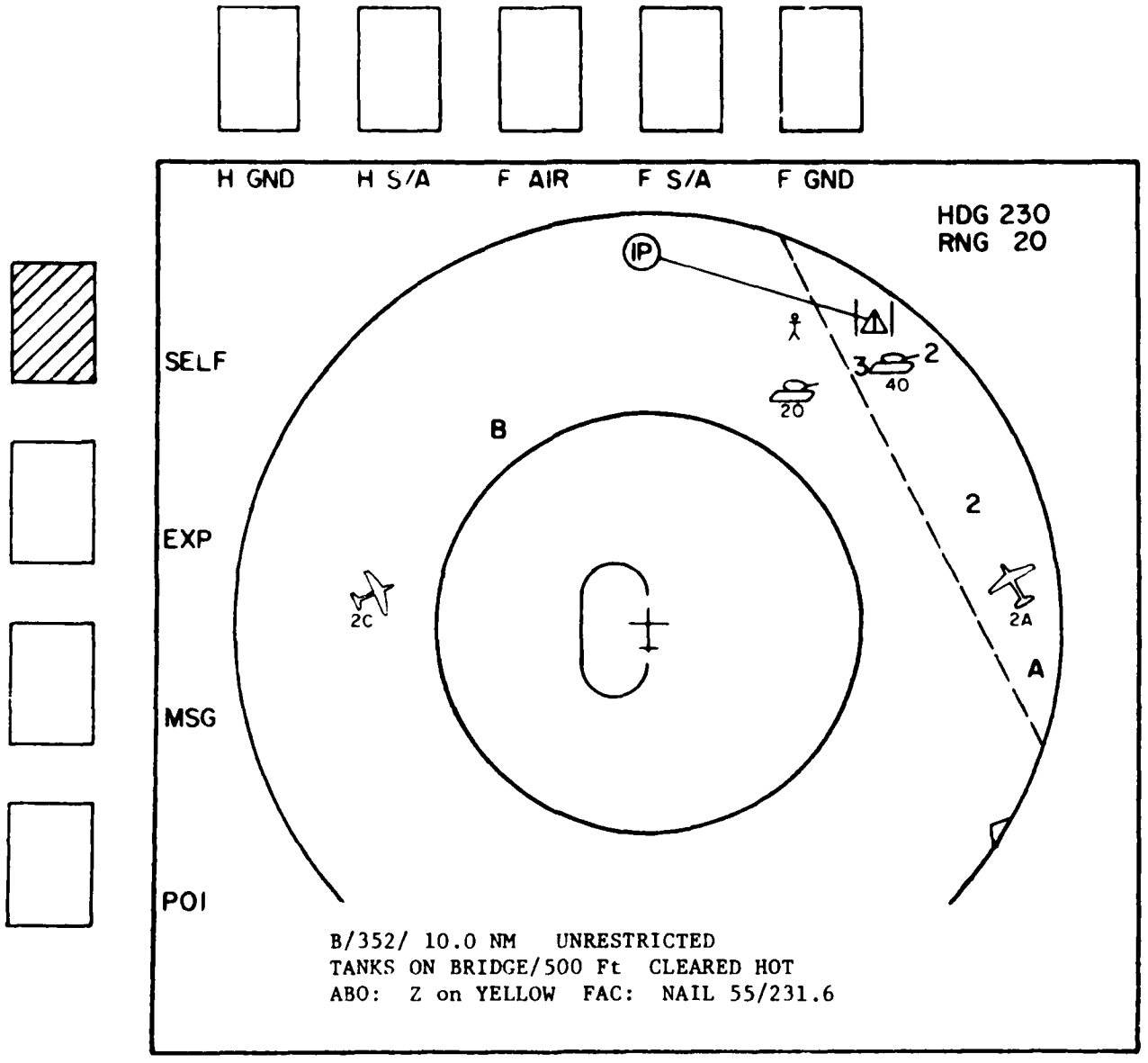


Figure 8a JTIDS CAS Mission

5. SUBJECTS

A total of 13 subject pilots participated in the study. They were currently operational pilots from TAC and USMC units, with experience in a variety of fighter aircraft. They represented over 33,000 flying hours. Flight time for the subject pilots ranged from 750 to 4900 hours. Four of the pilots had no combat experience while the others ranged from 300 to 1200 hours of combat time. Experience of individual subjects is shown in Table 1.

TABLE 1

SUBJECTS FLYING TIME

SUBJECT NUMBER	TOTAL FLYING TIME	TOTAL COMBAT TIME
1	1300	0
2	2500	400
3	1700	0
4	3200	300
5	2200	0
6	1700	0
7	1850	300
8	2300	400
9	2500	600
10 (USMC)	4000	1200
11 (USMC)	4900	550
12	4000	900
13	2400	300

6. EXPERIMENTAL DESIGN

Each of the 13 subjects flew eight missions. All pilots started with a CAS mission followed by an interdiction mission, and continued this alteration for the rest of their missions. Starting with a JTIDS mission for the first subject, each subject was alternately assigned to start his first pair of flights to either a JTIDS or no JTIDS condition. Following this initial assignment an ABBA order was maintained for each pair of flights. Table 2 indicates the overall design. It should be noted that although 104 missions were flown, data analysis was performed on 95 missions. Nine missions were terminated because of equipment malfunction.

TABLE 2

EXPERIMENTAL DESIGN

	Display Conditions	
	JTIDS	NO JTIDS
CAS Mission	13 subjects x 2 missions N = 26 missions	13 subjects x 2 missions N = 26 missions
Interdiction Mission	13 subjects x 2 missions N = 26 missions	13 subjects x 2 missions N = 26 missions

SECTION III

STUDY RESULTS

1. PERFORMANCE DATA

Figure 9 shows a comparison of percent of pilots who acquired the target across all missions. In the CAS missions, when JTIDS was available, the pilots acquired the target 92% of the time (22 of 24 missions). When JTIDS was not available, the pilots acquired the target only 46% of the time (11 of 24 missions). This result was statistically significant at the $<.001$ level as determined by the Cochran Q-test ($Q=33$). A similar result was encountered in the interdiction missions where 78% (18 of 23) of the pilots acquired the target when using the JTIDS net and only 21% (5 of 24) acquired the target without JTIDS. These differences were significant at the $< .001$ level using the Cochran Q-test ($Q=37$).

Additional analyses were performed across all test conditions for both CAS and interdiction missions to assess any practice effect. Table 3 shows pilots percentage target acquisition performance data for the first two and the last two missions under each condition. These data indicate a slight improvement in the JTIDS/CAS condition (85% to 100%) but the No JTIDS/CAS condition showed a substantial improvement (31% to 64%). However, even with this marked improvement in performance by the No JTIDS/CAS group, the CAS missions which used JTIDS were significantly better across the last two missions. McNemars test for significance of change verified this result at the $<.05$ level of confidence. Figure 10 graphically depict these data.

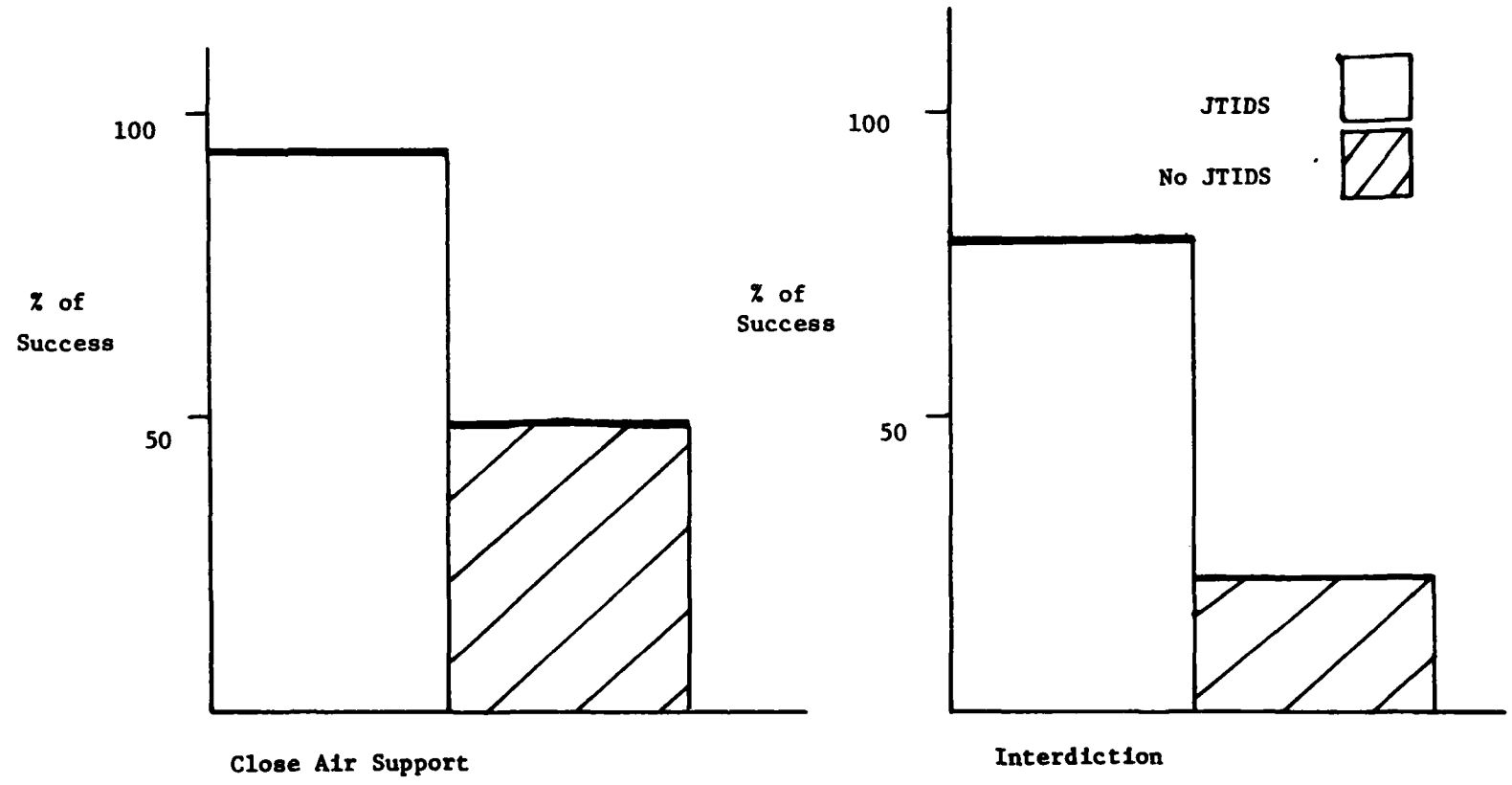


Figure 9 % of Pilots who found the target across all missions

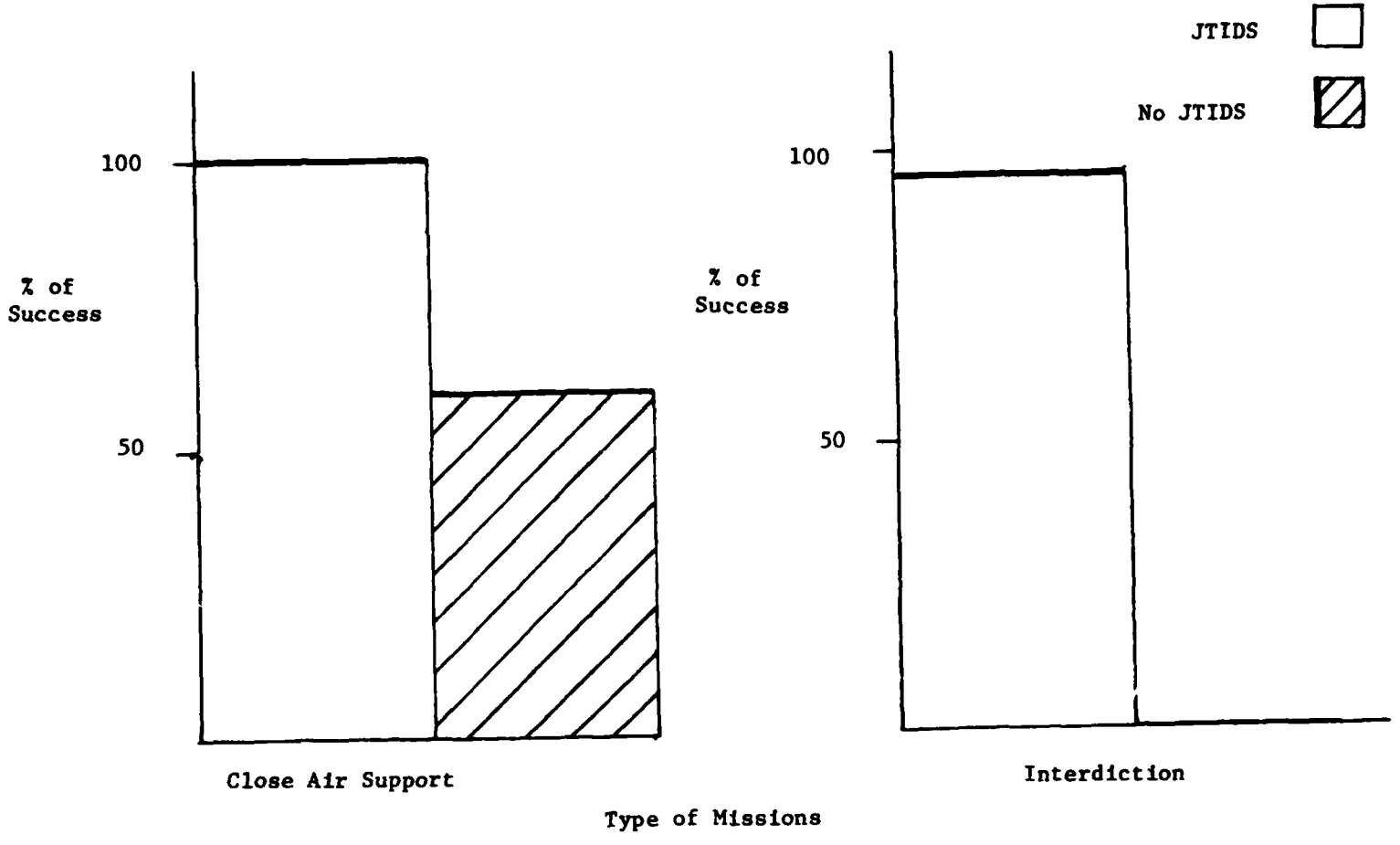


Figure 10 % of pilots who acquired the target (last two missions)

TABLE 3		
% OF PILOTS ACQUIRING THE TARGET ACROSS ALL MISSIONS		
Close Air Support		
	First Two Missions	Last Two Missions
JTIDS NO JTIDS	85% (N = 13) 31% (N = 13)	100% (N = 11) 64% (N = 11)
Interdiction		
	First Two Missions	Last Two Missions
JTIDS NO JTIDS	65% (N = 13) 38% (N = 13)	90% (N = 10) 0% (N = 11)

Analysis of the interdiction missions shows a somewhat different trend from the CAS data. The JTIDS experimental condition shows a substantial improvement in target acquisition performance (65% versus 90%), while the no JTIDS group actually showed a decrement in performance. This decrement is attributed to the latter two interdiction missions being somewhat more complex missions. Apparently, the advantages of having JTIDS more than offset this problem for the group using JTIDS.

Mean ingress time across all missions is shown in Figure 11. In those CAS missions where JTIDS was available, the average ingress time to the target was 339 seconds. In the No JTIDS/CAS condition, the average ingress time was substantially greater - 601 seconds. This statistically significant difference, determined by a t-test ($p < .01$), is attributed largely to the increased time required for communicating with the FAC on the voice channel. This issue will be further covered in the Discussion Section.

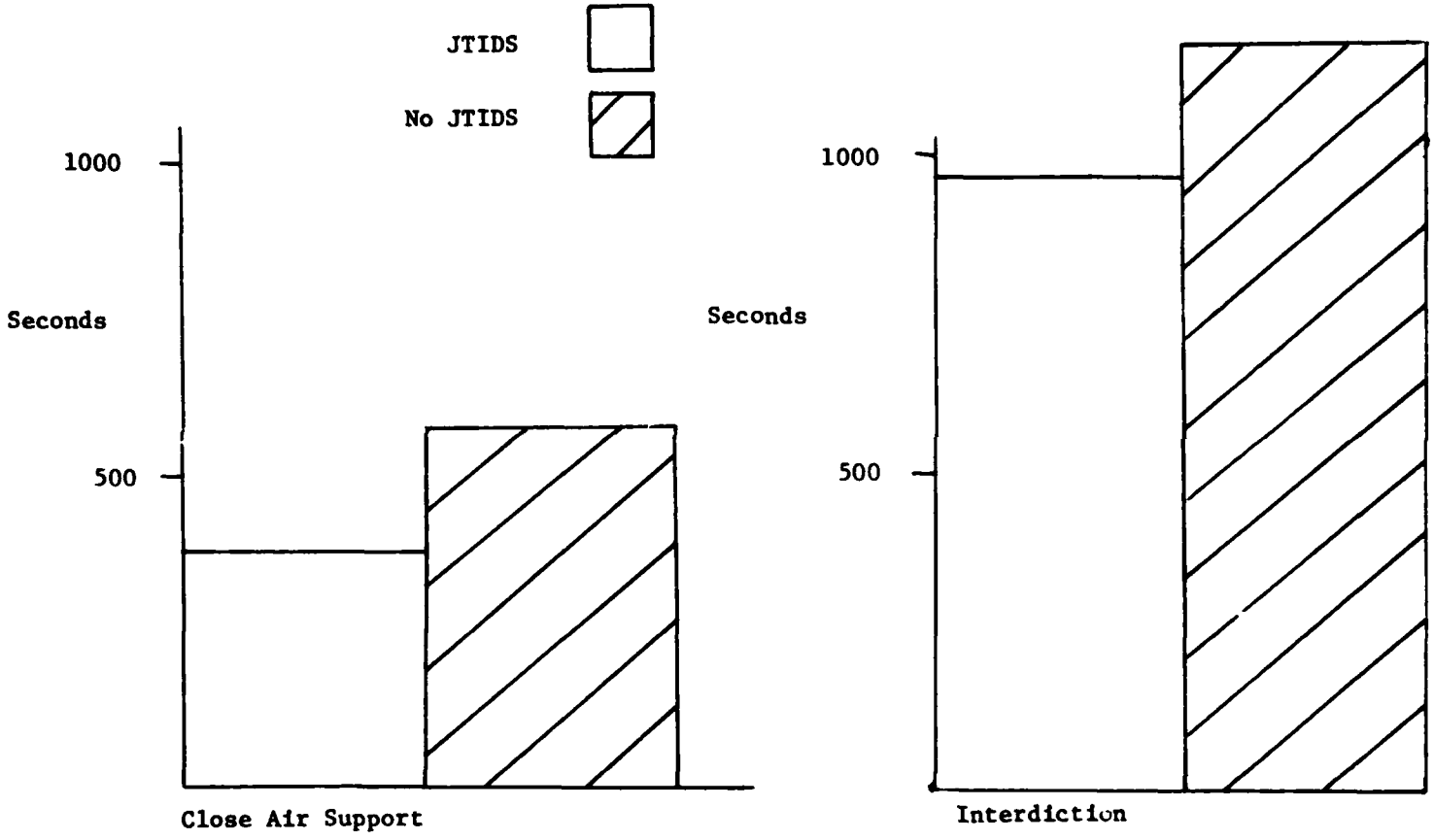


Figure 11 Ingress time across all missions

The data on the interdiction missions shows a similar trend to the CAS data; the JTIDS condition mean ingress time was 984 seconds and the No JTIDS ingress time was 1120 seconds. Although the differences were relatively modest (123 seconds) they were statistically significant ($P < .01$). A summary of the statistical tests conducted on the ingress data is shown in Table 4. Unlike the target acquisition data, the ingress data do not show a practice effect under either experimental condition. Table 5 summarizes the ingress data.

TABLE 4

STATISTICAL TESTS CONDUCTED ON INGRESS DATA

Close Air Support		
	t	level of confidence
JTIDS/NO JTIDS	3.09	< .005
practice effect (JTIDS)	.65	N.S.
practice effect (NO JTIDS)	1.32	N.S.

Interdiction		
	t	level of confidence
JTIDS/NO JTIDS	2.75	< .01
practice effect (JTIDS)	1.01	N.S.
practice effect (NO JTIDS)	.68	N.S.

TABLE 5		
MEAN INGRESS TIME TO TARGET ACROSS MISSIONS		
Close Air Support		
	First Two Missions	Last Two Missions
JTIDS	352.2 (N = 10)	531.2 (N = 11)
NO JTIDS	331.5 (N = 11)	703.5 (N = 11)
Interdiction		
	First Two Missions	Last Two Missions
JTIDS	999.6 (N = 11)	922.0 (N = 10)
NO JTIDS	1135.27 (N = 11)	1187.7 (N = 10)

2. SUBJECTIVE DATA

The questionnaire data collected following each mission, and at the end of all eight missions flown, indicated a very positive response and high acceptance of the JTIDS concept and display. This overall attitude is best exemplified by the pilots' rating of the degree of confidence they would have using JTIDS in a distribution of their ratings under the two experimental conditions is shown in Figure 12. These data indicated a definite difference in favor of the JTIDS system. In the same vein, all pilots said "yes" when asked if the mission benefited from JTIDS.

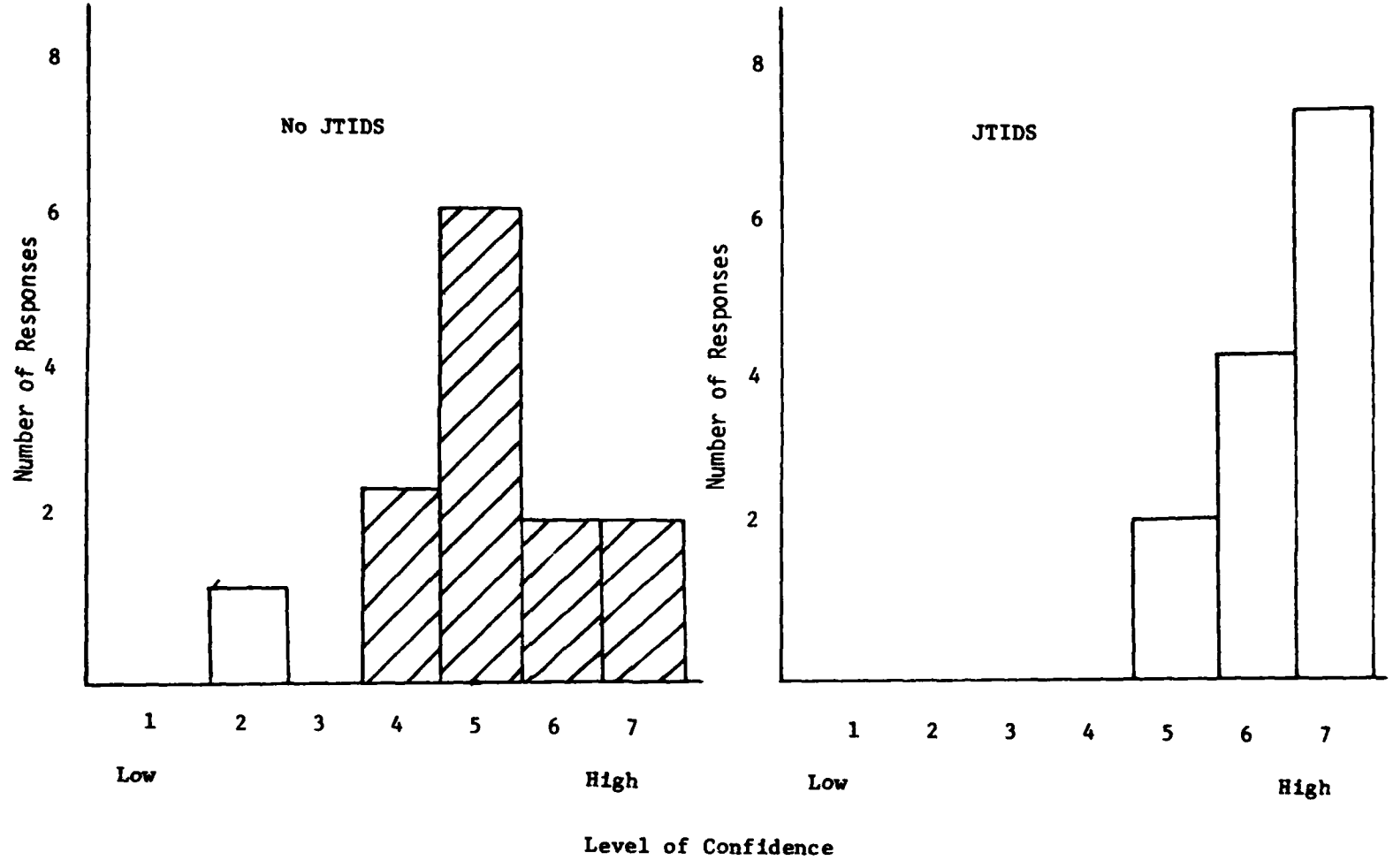


Figure 12 Level of confidence rating

Five of the pilots said that a big advantage of JTIDS is that it would allow single ship operation in a tactical situation. Many of the pilots also felt that JTIDS makes navigation much easier. One of the key comments, making reference to the ease of navigation, was that a pilot with JTIDS is in a better position to take advantage of terrain masking without becoming lost on a low level flight. Another comment was that JTIDS would make navigation much easier at night. Threat avoidance was considered simpler with JTIDS, because course control was easier, allowing more time to search for threats. Improved target acquisition was cited as a plus for JTIDS. Also the capability for reattack on a target was another advantage mentioned by several pilots. Increased target search time was given as a reason for better acquisition performance.

The biggest concern regarding JTIDS was the source and reliability of the data placed on the net. However, one pilot pointed out that even if only the location of friendly forces was reliable, it made JTIDS extremely useful. Negative comments concerned the implementation of mode switching and the gains on the cursor control. Both these items would be relatively simple to modify. In summary, the subjective data indicated a high degree of acceptance of JTIDS by all pilots who participated in this study. Individual responses to the questionnaires are in the appendix of this report.

SECTION IV

DISCUSSION

Both the objective and subjective results of the study indicate that JTIDS is tactically beneficial. The primary benefit increased probability of mission success was clearly demonstrated by the target acquisition performance data. In the CAS missions the advantage of having JTIDS was twofold. First, CAS missions with JTIDS allowed the FAC to pass target information on both the audio and visual channel, which attenuated the effects of communication jamming and greatly reduced the probability of misinterpreting the information. A second advantage of having JTIDS available was that once the information was displayed, navigating to the IP and acquiring the target was relatively simple. These two factors largely accounted for the significantly better target acquisition when JTIDS was employed on the CAS missions.

In the case of the interdiction missions, the difference in target acquisition performance was overwhelmingly in favor of missions having JTIDS - especially in the later more complex missions. These later missions were longer and gave more opportunity for error in navigation along the route. Therefore, without JTIDS, more than half the pilots were not able to find the target area, and those who did get in the area did not acquire the target. Even though the nonJTIDS group had an INS capability, they did not have the advantage of being able to anticipate turn points without referring to a map, which is difficult to do in a low level, high speed flight regime. The low task load navigation capability provided by JTIDS, also allowed pilots to deviate from their planned course to take advantage of terrain masking without getting lost. Without JTIDS such defensive maneuvers were much more difficult, and many subjects got lost.

Another potential benefit of JTIDS indicated by the results of this study is improved survivability in a tactical situation. The ingress time to target data in the CAS missions shows that with JTIDS it takes significantly less time to get into the target area, which means that the pilot is exposed to enemy defenses for a shorter time than he is without JTIDS. In the long run this decreased exposure time should result in better overall survivability. Longer ingress times without JTIDS were the result of the communication setup which required several repeats as well as time for the pilot to figure out his target location and attack heading from the checkpoint. With JTIDS all this information was instantly displayed and the pilot did not have to copy down the information on a knee pad for later reference. In addition, this shorter ingress time to target makes the JTIDS equipped aircraft more responsive to timely close air support which improves the survivability of ground forces. The interdiction data also shows less ingress time, but the differences were too small to have any practical impact.

The pilots also indicated in their questionnaire responses that the probability of survival would be greater with JTIDS. They felt that having the display of route information allowed them to take advantage of terrain masking and known threat information. The point was also made that providing the JTIDS information in an efficient manner, in one location, permitted the pilot to actually spend less time "eyes in the cockpit." This improves survivability in terms of low level terrain avoidance and visual acquisition of random threats. The comment that JTIDS requires less "heads down" time is interesting in view of the fact that JTIDS has been criticized on occassion for requiring too much heads down time. Closely related to the "heads down time" comment was the response by several pilots that they felt more comfortable flying at low levels when the JTIDS display was present.

The biggest doubt expressed by the pilots and others concerning the tactical use of JTIDS is the validity and reliability of the data displayed. This is particularly true of threat data, where no data at all may be better than having unreliable data. Exclusive of the threat data issue, the other types of information available on the JTIDS appear to be extremely useful. In conclusion, the tactical benefits of JTIDS described above are in essence due to an improved situation awareness leading to the ability to anticipate events, which ultimately results in maximum flexibility in the tactical arena.

SECTION V

CONCLUSIONS

1. The results of the simulation studies indicate that JTIDS offers the capability for low task load navigation, better communications, and improved situation awareness in the tactical mission.

2. The potential benefits of the system simulated are increased probability of mission success and improved survivability.

APPENDIX

PILOT QUESTIONNAIRE DATA

SUBJECT	MISSION	1. What changes would you make in the for more realism? (e.g., change the location of the hostile AAA).
1	1&2	Confusion factor missing, hours of mission planning and no multiple ship. Plus no one is firing at you so threat can be ignored only one counter.
1	7	Mentioned previously.
1	8	JTIDS Jamming should show up on JTIDS screen. Threats should shoot.
2	3&4	Need more visual triple A, & SAMs at stationary TGTS. More mobile ZSU, SA-6, 8, 9 with moving TGTS.
2	5&6	Increase threats in TGT area flashes, noise, etc.
3	1&2	The simulator video was very hazy which made terrain flying difficult. Recommend time, heading and distance be depicted on the map with time and distance ticks the way a real combat map would be.
3	7&8	More threats on the later missions would make it more realistic.
4	3&4	None.

5	1&2	MSN 1: High threat fighter orbits are never located over IP's or within the reach of IPs you used. It's fatal since IPs are near both friendly and enemy SAMs. Establish what at a contact point (CP) short of IP such as CP "A" to "B(IP)" to target. This permits scenic view orientation inbound to IP. From a real world view, one could look down and see IP "B" from aircraft.
5	7&8	None in particular when compared to prior missions. Near or FEBA there would not be many SA-Z. Plenty of SA-4,6,7,8, and 9's would be around as would ZSV-23's. Would probably find enemy aircraft anywhere but over their front lines.
6	3&4	Same as before. The video display is terrible. The maverick picture on mission 4 was worse than the video.
7	1&2	Scenario is good but visual display detracts so that I had to really concentrate on it to make out the presentation.
7	7&8	None.
8	3-6	Threats actually posing as a mission deterrent e.g. for a SAM call, pilot move at 4g's for 5 seconds to avoid being hit.

9	1&2	CAS Mission - Move holding point further from IP. Run-in from I to TGT should be more of a straight shot . Intradiction Mission - JTIDS was not properly synced to actual target (off left). MAV too in A/C). *The A-10 should not be thought of as an INTRADICTION Aircraft.
9	7&8	Relocate orbit point away from IP on CAS Missions. For CAS mission use a tank formation heading with localized AAA/SAM requiring standoff capability and maximum terrain masking.
10	3-6	Scenario is good - Lack of color on presentation presents problems in TGT ID.
11	1&2	Nothing.
11	7&8	None.
12	3&4, 5&6	Because of the limited visibility it is very difficult to cross directly over the FAC IP to get a good time hack and heading outbound. I miss copied the distance as 10 miles instead of 4.5 miles. My DR of 2 min was wrong and I didn't see the TGT in time to attack the first pass. On a 180 reverse I did get a gun shot and when I attacked again from the IP I got an AGM 65 hit.

13	1&2	Using JTIDS on the first with jamming as it was gave good information for source only. This allowed me to ignore any threat that may have otherwise distracted.

SUBJECT	MISSION	1B - What changes would you make in the scenario for more realism? (e.g., change the location of the hostile AAA).
1	3&4	Mentioned previous.
1	5&6	Have threats fire at you, perhaps have enemy planes appear somehow. Aircraft flew with induced right roll. Visual display plus altitude shown where different.
2	1&2	Did not really notice hostile fire. Suggest more emphasis on this fact.
2	7&8	None.
3	3&5	Some side video would sure help.
3	6	The simulator stopped working in the target. area. If it worked it would have been pretty realistic.
4	1&2	The only serious limitations were the poor quality of the visual display made it very difficult to navigate much less find a target. The map could have had some more details such as towns, bridges, etc for easier navigation.
7	3,4,5,6	None.
8	1&2	Did not consider threats this mission because of JTIDS display and task saturation flying route.

8	7&8	Threats from the ground that would really affect the mission.
10	1&2	Ensure IPs are easily identifiable. FAC Brief is incomplete. (IP, distance, elevation, friendlies pull off, higher terrain, enemy situation.)
10	7&8	Scenario is realistic.
11	3&6	None, its adequate/typical as is.
12	1&2	Without JTIDS or any other warning system there was little information about any threat that was present. However with the same equipment on an aircraft you wouldn't have any more warning then you have in the simulator.
12	7&8	Raise the horizon on the video display so you don't have to push the nose over to see where you are. Color visual display and color maps would be more realistic. Prominent land marks such as towns, factories, airfields, dams, roads, etc are also clearly marked on aero charts that are used by combat crews.
13	3&6	Add color so water is water, etc. Put in flashes (red light) when close to ground, possibley below 300. This would eliminate a lot of unnecessary noise that takes away visual clues.

SUBJECT	MISSION	2. What additional information would be helpful on JTIDS? Please be specific.
1	1&2	More information might truly add to the confusion. There be a better way to discover the JTIDS is being jammed, like a flashing light on the JTIDS itself.
1	7	None, JTIDS information was wrong for IP. IP was point "C".
1	8	More information would cause saturation.
2	3&4	Information is appropriate.
2	5&6	Most adequate for mission.
3	1&2	None.
3	7&8	None.
4	3&4	Ground proximity warning. Any time you are looking inside the cockpit during low level flight, it is possible to be distracted or become involved and neglect maintaining a safe altitude. A ground proximity warning system would provide a safety factor to cover this problem.

4	1&2	I would prefer a pushbutton or touch button selection for ranges with the throttle switch option available. To change range I have to trigger the throttle switch too much, then read data to make certain I have correct range. For point of interest designation, let punching POI button designate at aircraft position and then remain fixed over point designated only. Information of interest can be called to AWACS in relation to that point e.g., "Hog" Mark, 20 Tanks, 350 for 2 NM, stationary targets. Again it is one switch action. At low level, too many actions besides flying aircraft are fatal sooner or later.
5	7&8	Include "Prompt" between P and TGT - "WEAPONS ARMED" in big letters.
6	3&4	At low level the POI mode is almost impossible to use. Safety is impared. Slewing is dangerous at low altitude also.
7	1&2	I would like real time information tied into RWR.
7	7&8	Real time information would be nice.
8	3-6	Useful as it was.

9	1&2	A-10: Put a NAV mode in HUD leaving following information in that mode. This way you can use basic JTIDS for navigation while keeping friendly/enemy ground/air threat information. Put message traffic on present screen below glare shield. Information printed out in HUD would be automatic after passing last point (i.e., like tacan to/from indication 90 degrees off port/starboard). This way you have basic NAV, with more advanced friendly/ threat information lower. An A-10 pilot cannot afford to bury his head in the cockpit.
9	7&8	Use basic NAV mode with HUD display giving waypoints as you progress on routing. Waypoint target information should be automatic and update itself to the next waypoint as soon as you pass abreast of the last point. Maintain additional information about enemy and friendly forces on lower scope.
10	3-6	Information adequate. If ground commanders can update as they move it will provide real world picture. NAV mode super. Pilot skills and MSG of information progresses on every sortie.

12	3&4, 5&6	For short runs like 4.5 mi it might be nice to have a 5 mile scope instead of a ten mile scope. Actually an IP should give you a minimum of 1 min to the weapon release point and 4.5 NM does not give you enough time to really lock on and fire.
13	1&2	A heading on the right side of the display labeled "To PT", "To IP", or "To TGT" would allow for less concentration on JTIDS display. Would eliminate point nose of aircraft at point.
13	7/8	On right side of scope under heading of aircraft, a printout of distance and heading to next point would allow for better planning of route. To use "POI" distracts greatly from aircraft control.

SUBJECT	MISSION	3. What additional information would have been useful in the cockpit? Please be specific.
1	3&4	Good INS that I could update quickly. That is where JTIDS is useful for the A-10.
1	5&6	Accurate INS with DME update capability.
2	1&2	For a mission w/o JTIDS - the mission information was very adequate. However, limits of pictorial capabilities make for a tough INS mission only.
2	7&8	See prior writeup.
3	3&5	An INS, + WRCS. The digital clock is super. One should be installed in all fighter aircraft. A combat mission folder (map with tick marks, leadings, times, etc.) would have helped.
3	6	None.
4	1&2	A radar altimeter for all missions - For low level visual flying, AGL altitude and ground proximity warning are essential to safety. An INS, especially for this interdiction mission. An INS is a tremendous aid to navigation on a low level terrain masking profile and is very helpful in

		reestablishing orientation following defensive maneuvering to negate a hostile ground/air threat. Secure voice or other jam resistant communications would be very useful for receiving close air support target information.
6	1&2	An inertial navigation system would be invaluable. This would allow the pilot to make numerous deviations from course and still assess his location in respect to the target or turn point. A low altitude radar altimeter would be invaluable. It's criminal that the A-10 does not have one. Any low level aircraft should have one for safety sake. When the pointer goes through a certain altitude, a red light goes on.
7	3&6	Did not have a moving map (A-7) or JTIDS. Just using DR is always harder. JTIDS would have been useful for CAS.
8	1&2	INS heading to turn points. Radar altimeter information. Color monitor for terrain picture for better discrimination of ground references.
8	7&8	None.
10	1&2	INS - i.e., waypoint steering. Visual display; i.e., black and white - does not help.

10	7&8	None.
11	3&6	JTIDS.
12	1&2	An inertial system would be a great help. Dead reckoning (DR) has never been easy when you are forced to vary course from preplanned. Inertial solves all this. A HUD display with altitude and airspeed would help for the visual DR problem.
12	7&8	Inertial NAV Equipment. RWR-Radar Warning Receiver. AGM65 video to get more detail (it was out on my nav mission). HUD-with airspeed, altitude, and flight path indicator.
13	3&6	If I had steering to the IP, the chances of properly identifying it would be much greater (INS).

SUBJECT	MISSION	4. Were there segments of the mission where you felt the workload was excessive? Please explain.
1	3&4	Workload wasn't excessive but when you get lost there was not enough of the right kind of information to get you on course.
1	5&6	Yes, if you didn't know the area or route well the visual display only confused you. Also, if you boresighted your mavericks, any disruption like running into ground, or accidentally moving the JTIDS/Nav selection switch, changed your boresight.
2	1&2	No. Very realistic. In fact, the workload was easily handled.
2	7&8	The entire low level interdiction was much more demanding w/o JTIDS. On JTIDS missions this was alleviated.
3	3-5	Yes. Trying to navigate through a valley that looks the same as the next one.
3	6	Finding the target was difficult, otherwise I did not feel overloaded.
4	1&2	Target acquisition difficult due to poor video display.

6	1&2	The poor visual display raises the workload in trying to navigate and keep from hitting the ground.
7	3-6	None.
8	1&2	Got lost on route due to: 1. Unfamiliarity w/route 2. Lack of ground color contrast 3. Lack of side field of view 4. Confusion due to video movement slightly uncorrelated with aircraft control inputs
8	7/8	Extremely difficult to navigate visually with video limitations.
10	1&2	No.
10	7&8	N/A
11	3-6	No, except for simulator flying workload missions do not seem excessively complex.
12	1&2	Navigation and writing down information on an unfamiliar card. I had trouble remembering the FACs call sign. My memory is great but it is a little short.

12	7&8	DR is very difficult for a couple of reasons. 1. You don't know when you are actually over a check point and this prevents accurate time checks. 2. The A-10 is so under powered it is difficult to maintain 300 kts and stay close to the ground. (You can't maintain speed climbing over hills.)
13	3-6	Yes - Coping the FACs instructions with poor communications causes me to write down the wrong heading. Multiple firings of maverick on one pass caused me to almost hit ground.

SUBJECT	MISSION	4. Were there segments of the mission where you felt the workload was excessive? Please explain.
1	1&2	CAS does that. I needed cards, etc to write on to clue me about what to ask for and what information to give.
1	7	No.
1	8	No.
2	3&4	Yes, could never seem to slew the maverick smoothly. TGTS were fuzzy unless on maverick. Made for late pickups.
2	5&6	No.
3	1&2	Yes. Trying to fly through the valleys using JTIDS to stay on course and monitor air and ground threats was extremely demanding. A WSO sure would have come in handy. He could have analyzed the threats and course corrections while I avoided the rocks and trees.
3	7&8	Yes, it was excessive trying to avoid the ground, read the map and work the JTIDS. I felt far more comfortable with the JTIDS than without it.

4	3&4	None. At one point WX response was requested while I was working an air target with the cursor and the TRW point was coming up. To accomplish all would have been excessive, but it was easy enough to ignore the request and delay moving this cursor until established on this new track.
5	1&2	Yes but this is related to my proficiency with A-10 simulator and JTIDS weapons switchology vs my experience with them. Simulator visual focus. Cockpit lighting. Map terrain contrast all black on white. Color is very helpful. Again my proficiency should increase.
5	7&8	The greatest workload was occurring when I was cross checking map data with JTIDS. It is nice to depend on JTIDS map's and maps and clocks are more reliable DR.
6	3&4	Only when trying to slew at low altitude.
7	1&2	In a high threat environment the pilot can not afford to spend much time in cockpit. The system works fine but I feel that there will be many times when the pilot is going to be over saturated to the extent that it might not be possible for him to spend much time looking inside.
7	7&8	No. Getting used to system and simulator.

8	3-6	Terrain Discrimination (due to lack of color and limited field of view) took a disproportionate amount of time and concentration to fly, avoid obstacles, and navigate. Visual navigation was next to impossible without a great amount of familiarization with the terrain itself.
9	1&2	When low to ground - having head in cockpit for more than 4 seconds to capture new waypoint/IP/tgt. In reality one can not expect to have your head in the cockpit after approaching IP. JTIDS takes you the shortest route between 2 points which may or may not be the best route due to threat threat considerations and required terrain masking.
9	7&8	Never felt workload excessive this time around.
10	3-6	No.
11	1&2	Many as far as simulator handling is concerned. Pitch sensitivity/Response/ Instability causes excessive over control. Need combining class [illegible] flight information.
11	7&8	No.

12	3&4, 5&6	Moving the cursor took more time then needed. Also the cursor should remain in the same relative position on the scope when changing range. Also, switching from JTIDS to maverick it is easy to get confused as to which mode you're in.
13	1&2	No - I didn't do too much. I did have weapons switchology problems. Resetting the simulator required me to reset the NAV's.
13	7/8	Anytime I used JTIDS to identify hostile aircraft, my aircraft control suffered. Doing this at a very low altitude would be very hazardous to a single-seat pilot.

SUBJECT	MISSION	5. If not mentioned above, how did you feel about performing normal pilot duties while concurrently using JTIDS? Please explain.
1	1&2	Great. I think the simulator flying characteristics made it hard to do two things at a time, but on a real aircraft its more stable and can be left alone for nanoseconds. JTIDS is only as good as the information it gets. If that information is bad, aircrew will not use it except as nav aid, RHAW display etc.
1	7	Great.
1	8	JTIDS made most duties easier. Nav, threat recognition, and information recall aided by JTIDS.
2	3&4	No problems.
2	5&6	No problem.
3	1&2	I was uncomfortable due to the newness of the simulator. All I could get from JTIDS was course guidance and minimal threats. I spent most of my time looking outside the aircraft.

3	1&2	As I became more familiar with the simulator I could use JTIDS and perform normal pilot duties.
4	3&4	The "Basic" track, threat, etc. JTIDS information requires significant time or actions (other than changing ranges). The "Nice to Have" features, such as POI, cursor interrogator, etc can only be used when conditions permit. For example, during a low altitude turn, the only required information is track to the next point. Any manipulation of JTIDS would detract from safety. But it is no problem to integrade JTIDS operation with normal pilot duties.
5	1&2	I like using it for navigation. My familiarity with it is still too new to use it to full capacity. In low level environment, expect minimum use for other than navigation. The lower you fly, the more dedicated the pilot must be to simple flying. JTIDS give situation awareness of navigation, attack, and reattack problem that permit minimum use of map. Excellent situation for high speed very low level flight.

5	7&8	See 4. There is excellent opportunity to execute short notice, low profile information attacks at medium altitude. However, if JTIDS got "screwed" one may as well go high at the start to rapidly orient himself to the task. Personally, I like using JTIDS but at low altitude, high speed - too much involvement with it can cause trouble. Low altitude flying is principally a "head out of cockpit" event.
6	3&4	JTIDS was a tremendous help. It was similar to an INS in that you could deviate and terrain mask better, and still knew exactly where the target was.
7	1&2	My current skill level along with unfamiliarity with the simulator made it difficult. With practice it is felt that it would enhance the aircraft.
7	7&8	JTIDS would be very useful in a CAS mission or any mission that could not be preplanned.

8	3-6	JTIDS was a super aid for navigation and actually gave me more time to concentrate on flying the simulator. I consider it a necessity in navigating this simulator with limited field of view. The voice commands were effective in getting attention - The female voice pitch especially because it is not usually heard on the radio in a combat environment. On several occasions I looked in the direction of reported SAMs and aircraft before I looked at the JTIDS display.
9	1&2	Was not accomplished since any extra duties must be accomplished prior to entering threat area due to attention required for visual search (air-air) and target ID.
9	7&8	I felt much more at ease with JTIDS than using time and distance. I think a better way is to use as a NAV function on the HUD as previously explained. We need to keep heads up as much as possible.
10	3-6	No problem - Msgs of any significance should flash to alert pilot - Wx etc the pilot will get to when he gets a chance.
11	1&2	OK.

11	7&8	I think its a definite advantage to have - however, all aircraft are not the size of the A-10. Some aircraft would have to sacrifice to insure dedicated display (weight, size, etc). Looking at integration without trace video display(s) at the WST of color coding.
12	3&4, 5&6	JTIDS is a good aid to navigation and enemy warning. I don't believe it should be a separate system however, it should be combined with the radar warning receiver (RWR) the weapons panel with JTIDS hopefully will never be done in an actual aircraft. The work load of operating the weapons control system is not being done so it is hard to know just what the work load on the crewmember is.
13	1&2	I had difficulty with altitude control - some due to poor division of duties, some due to unfamiliarity with the simulator picture.
13	7/8	None.

SUBJECT	MISSION	6. Do you feel the mission benefited from the JTIDS capabilities? Yes, No, Why, or why not?
1	1&2	Yes.
1	7	Yes. helped avoid threats.
1	8	Yes.
2	3&4	Yes. Easier to fly. Could deviate from track. Less time w/head in cockpit. I firmly believe JTIDS allows more head-ups than dead reckoning (DR) w/map.
2	5&6	Yes. Did not have to maintain preplanned route in order to hit TGT.
3	1&2	Yes. Course guidance was excellent. Depicting ground and air threats was also very helpful.
3	7&8	Yes. Checking six. Staying on course - or getting back to course.
4	3&4	Yes. It provided an easily interpreted display of information currently provided by INS, RHAW and map displays, as well as weapons status and control displays.
5	1&2	Yes. Navigation workload diminished.
5	7&8	Yes. Ease of navigation.

6	3&4	Yes. Ease of navigation. Real time information on good and bad guys.
7	1&2	Yes. Extremely helpful for CAS/would be a good way to negate communication jam.
7	7&8	None.
8	3-6	Yes. Aided greatly in the navigation problem. Easy to see route in a dark cockpit on JTIDS, map in hand hard to read in dark.
9	1&2	Yes. Anything that can assist the pilot in accomplishing target acquisition is a benefit. JTIDS can be employed in its present position, but not as effectively as it should be. A more effective way would be to employ it in the HUD for NAV purposes giving the solo pilot a chance for complete heads up at all times.
9	7&8	Yes. My feeling is that JTIDS greatly increased my heads up time allowing me to see what was going on outside. This is vitally important when flying in the low altitude arena.
10	3-6	None.
11	1&2	Yes.

11	7&8	Yes. Valid Nav aid to tgt with minimal scan requirements.
12	3&4,5&6	Yes. It was the only substitute for inertial Nav and RWR. Both are necessary when operating in an area where you must avoid enemy activities.
13	1&2	Yes. I would have gotten lost otherwise due to poor pilotage.
13	7/8	Yes. Map reading in a low visibility situation can lead to very poor navigation. JTIDS helped me to identify points along the route.

SUBJECT	MISSION	7. What problems, if any, were encountered with the system? Please be specific.
1	1&2	None, except that it was not easy to tell when JTIDS was jammed.
1	7	JTIDS shown IP.
1	8	None
2	3&4	Maverick seemed to cage as much as 30 degree off A/C heading at times.
2	5&6	None JTIDS. Clarity of cockpit display (picture out front) left something to be desired. Was not VFR mission; closer to IFR. Especially TGT area.
3	1&2	The cursor was difficult to position over designated positions. I found myself spending too much time trying to position the cursors when I should have been flying the aircraft.
3	7&8	The cursor control was a little difficult to work sometimes. At times it moved slow, and at others it was very fast. A moderate to slow rate is better than a fast rate of movement. That way it would be easier to position the cursor over a point.

4	3&4	It is difficult to make small movements with the cursor. Suggest slew rate be reduced significantly.
5	1&2	Simulator focus and clarity, JTIDS vs Weapons Switchology is complicated. Things should improve with my proficiency.
5	7&8	None.
6	3&4	Dangerous to slew at low altitude.
7	1&2	None.
7	7&8	None.
8	3-6	Lack of familiarity in operation. Throttle switch for NAV/JTIDS slew was difficult to operate precisely.
9	1&2	2nd mission (intradiction) - JTIDS did not line up properly with the actual target tracking. It was situated off to the left.
9	7&8	The use of the cursor causes too much heads down time. Therefore, you need an automatic print out of waypoints/IP/target as flown (once abreast point change information to next could have automatic print out feature on regular JTIDS panel off any threat aircraft. The cursor just takes to much time.

10	3-6	None.
11	1&2	No. Pilots w/JTIDS display could be smaller. ACs AV88/F-18 MPD combines computer video/EHSI and TV/LST video.
11	7&8	None.
12	3&4, 5&6	No memory on the cursor which required resetting when ranges were changed.
13	1&2	I did not understand the action, if any required when enemy activity was directed towards me.
13	7/8	After identifying a hostile aircraft, I could not remove the display from the bottom of picture.

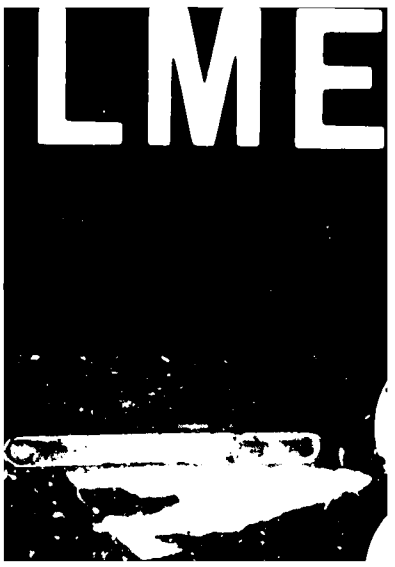
SUBJECT	MISSION	8. Do you feel this type of system capability (JTIDS) would change the tactics you presently use? Please explain.
1	1&2	Yes, if necessary and the information is accurate you could go single ship. Reattacks would be easier. Also if tapped by a MIG, and you defeat the attack, you'd be better able to return to course.
1	7	Modify, and aid greatly, would allow single ship.
2	3&4	Yes. Would not be a slave to time and distance. Could use better terrain masking without worrying about becoming lost on Low Level (LL).
2	5&6	No. Would enhance. Not restricted to time and distance to hit TGT.
3	1&2	Yes. Single ship missions could be flown rather effectively with the ground and air threats easier, especially if you are driven off course with a defensive turn. More time could be devoted to searching for the target, and threats.
3	7&8	Definitely. Single ship would be very possible, checking for threats and avoiding them early would also be possible. Course deviations would be much easier.

4	3&4	In the F-111, four displays/panels are required to provide the basic JTIDS information and not all are available to both crew members. I feel that JTIDS provided the information in a far superior manner. As far as tactics, JTIDS display of navigation/threats information allows for easier threat avoidable without sacrificing navigation accuracy. That is assuming the accuracy of JTIDS inputs. Knowing the errors which occur in INS, an improved capability is required.
5	1 &2	Not the tactics itself. JTIDS would be integrated in our scan in order to amplify our situation awareness.
5	7&8	Don't except one doesn't have to reexamine the flight line-up card.
6	3&4	Change in that you can deviate around SAMS, AAA, etc. You know where the TGT is at all times, and where everyone else is. It's a very good system.
7	1&2	Yes would be ideal for a CAS/The present system is almost unusable in a communication JAM/High threat environment.
7	7&8	None.

8	3-6	Possibly. Knowing where threats are could change tactical formations for target ingress. Single ship ingress would be more feasible. Move concentration on flying low level would be possible with less time of head in the cockpit reading maps. Also would be nice in communications jamming environment. Simulator dynamics are not good. Too sensitive in pitch control (NZ onset seems too high and too soon.) Turn (yaw) rate seems excessive and gives the impression of velocity while wings level.
9	1&2	No, but it would greatly assist in getting us to the IP. Especially in Europe where most people will not be familiar with the localized terrain and all towns look alike. It is imperative that we have everything going for us that we can. Putting the NAV function in the HUD display greatly facilitiate our mission. **The A-10 does not need or should be employed in an intradiction mission.
9	7&8	No, but I do feel that would greatly complement them. It would free up the flight lead from navigation workload allowing more heads up time for searching for enemy threats (air/SAM/AAA). A prime example of the need for more heads up time is of the first A-10 squadron to deploy to Germany and operate in that environment. The biggest problems they encountered were: Navigation - all towns look the same. Air threat - due to problems of navigating, they were unable to devote the proper time for visual look out and "got ate like a grape" i.e., no ordinance on target.

10	3-6	None.
11	1&2	No, but would enhance success of current tactics if fairly valid (real time - Biggest drawback would be garbage in - garbage out (poor intel).
11	7&8	None.
11	3&4, 5&6	No. It is just another source of RWR and inertial navigation. Don't get me wrong, JTIDS has the potential of displaying more of the enemy battle of order then an RWR and the navigation display is more graphic then the inertial display on the HSI. I prefer the JTIDS display and data but it won't really change my tactics. I would fly my mission the same no matter where I got the data from. If you know there is a MIG at your six you are going to react no matter how you found he (she) was there.
	5&6	I sure missed having a sweet calm voice tell me that a "SAM 3" had locked on, tracked, and fired at my fraging body. The soul lives forever but the body it needs all the tender loving help it can get to stay in working order. Please bring back the voice warning for SAMs. We need a memory for data displayed on JTIDS. This applies to the cursor. For example, waypoint 3 put under the cursor on a 20 nm scope. The bearing, dist, tot, etc are displayed

		now if I switch to 10 miles and waypoint 3 is no longer on the scope. You should be able to retain the cursor data until the cursor is moved but now you lose it all.
13	1&2	Somewhat, if confident it was accurate, more maneuverability prior to the IP and on reattacks would be possible, threat permitting.
13	7/8	Yes - Given reliable information it would allow a "CAS" pace to be much more flexible and fighters could maneuver a great deal more outside LINE-OF-SIGHT of the TGT.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